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Methodological Proposal To Identify The Physical Losses In The Argentinean Dairy Value Chain

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ABSTRACT

The Argentinean dairy value chain (ADVC) processes around 10 billion litres per year, with an annual turnover of USD 8.993 billion in factory dispatch. However, physical losses (PL) represent approximately USD 250 million per year when the entire chain reports USD 184 million in profits. This research aims to identify physical losses in the dairy value chain as an opportunity to gain productivity, competitiveness and sustainability.

A survey in the ADVC carried out through surveys consisted of semi-structured interviews with dairy company representatives and a specific questionnaire. The survey included one-third of the companies in the sector (577), representing almost 80% of the total raw milk processed, during 2018 and 2019. The descriptive-quantitative analysis made it possible to analyse and interpret the data collected to provide alternatives for improvement arising from identifying the origins, causes, and factors of physical losses in the dairy value chain.

The results obtained show that the primary origin of PL in the ADVC is generated in the processing stage and is mainly caused by "Human errors" due to Training, Internal communication, Automation level, Operating instructions, PL Policy and Culture.

Finally, the study concludes that companies can improve their performance, become more competitive and sustainable by prioritising management actions before investing and providing a framework to implement the necessary changes.

Keywords: dairy goods, physical loss reduction, top management decision-making, semi-structured interviews, waste management, cleaner production.

INTRODUCTION

In a competitive and challenging international environment, dairy companies must optimise their production and market performance to survive (Guan & Philpott, 2011). In this context, there are different ways to achieve that competitiveness. One of them is to reduce food waste generated in the chain value to improve the efficiency of food systems (Garcia-Garcia, 2017). This aspect is not entirely top management's focus these days (Aikenhead et al., 2015).

In the Latinoamerican context, according to Lima et al. (2018), by optimising the available resources, Brazilian dairies can be more competitive, primarily by reducing their consumption of water and energy and losses in their processes. Based on the idea that dairy products can cause negative impacts on the environment, Santos et al. (2018) propose to use techniques, like Cleaner Production (CP), to avoid and minimise these impacts, propitiate production efficiency, economic gains, and a better working environment. Nevertheless, its application is still minimal because there are barriers at the managerial level. So, managers need to raise their level of awareness to understand that the potential economic benefits justify analysing losses, particularly in Small and Medium Enterprises (SMEs). However, large size companies are not permanently excluded (Ramos et al., 2018). In Argentina, the Industrial Reconversion Program (2019) is a plan of activities to improve industrial and service establishments' environmental performance and management. With a voluntary adhesion and through an accompaniment plan, it implements changes in processes and operations to reduce the environmental and social impacts generated and the application of mitigation and remediation of environmental liabilities. However, its effects are still limited, and its focus is more on an industrial level, not covering the supply chain.

The Observatory of the Argentine Dairy Chain (OCLA) analyses by Giraudo (2018) that this chain lacks the conditions for competitiveness based on economic, social and environmental sustainability, even though it has comparative advantages. There is a need to have competitive costs to achieve profitability, productivity, and efficiency. According to Galetto (2018), factors such as higher quality and differentiating products provide advantages not based on prices. One of those factors considered is the reduction of Physical Losses (PL). At present, there is no published data on the economic impact of losses on the Argentinean Dairy Value Chain (ADVC). Therefore, PL deserves a specific treatment to determine their Origin, Causes and possible alternatives for optimisation through some methodology that facilitates an economical, sustainable and comprehensive approach. In this context, this research proposes an approach to identify the Origins and Causes of PL in the Argentinean dairy value chain. The study goes from when the milk enters the plant, through transformation and distribution, until it reaches the customer. It strives to find opportunities and challenges that induce top management to plan and execute the reduction of PL. It also considers that their appropriate estimation facilitates an adequate technical-economic pre-feasibility study.

This communication consists of five sections. After this introduction, a bibliographic review was about different approaches to identify, treat and reduce PL. Then, the methodology proposed to highlight what the Argentine dairy industry perceived. The following section analyses the data obtained. Furthermore, finally, conclusions about opportunities were discussed in the last section.

LITERATURE REVIEW

There are plenty of articles in the literature regarding improvement losses coming from different systems of the sustainability field. As the environment, cleaner production (CP), pollution prevention (P2), eco-efficiency, eco-design, life cycle assessment, waste minimisation, and environmental accounting, amongst others (Glavic & Lukman, 2007). In the academic field, the CP framework included the PL, a methodology with many developments at the international level and a massive promotion by the United Nations Environmental Programme.

The CP emerges as an approach to preventing waste generation, guiding companies in their environmental management system to contribute to competitive advantage, improve their performance, and lay the foundations for improvement in profitability and minimising impacts on the environment. However, there is little application in companies, except in some large ones. Nunes et al. (2019) identify barriers linked to top management and their impact on employees' commitment, underestimating environmental problems and risk perception, and highlighting non-compliance with environmental regulations. Khalili et al. (2015) summarise that CP strategies could lead to sustainable development, highlighting the educational role of the academy, educating most managers.

Brazil's dairy sector developed lines of work that contribute to improving processes and a better financial result, environmental protection and improvement in the work environment. Barriers at the conceptual, organisational, technical, economic, financial and political levels do not facilitate its deployment in organisations (Santos et al., 2018). Vieira & Amaral (2016) identified internal and external barriers in adopting the CP practices from a review.

Despite being challenging to implement in SMEs due to their generic nature, the principles in CP point in the right direction because they provide the basis to be sustainable. Also, Cotrim et al. (2018) propose integrating quality management tools into the CP program and promoting senior management's commitment. In the same address, Silva et al. (2013) highlight the importance of working with the commitment of top management and the motivation of employees. From a pollution prevention (P2) point of view, Aikenhead et al. (2015) report the need to find ways to achieve employee engagement. Applying the causal loop diagram and map the processes to make them participate in the decision-making process in a dairy company.

In the search to facilitate the CP implementation, the standard CP methodology integrated quality tools. The Deming Cycle (PDCA: Plan-Do-Check-Act) is an excellent example since it improves some aspects of other proposals in the analysed literature (Silva et al., 2017).

In Argentina, the National Quality Award (FPNC, 2019) promotes the concepts of continuous improvement in business organisations. A quality process improvement presents a series of steps to think about and work through, providing a framework that guides managers from the

initial improvement challenge to completing the effort. However, the effect of intangible factors such as internal communications and climate, culture, self-reflection and consensus, is largely unknown, and the continuous improvement process would benefit from further research on those areas (Formento et al., 2013).

To integrate quality tools, Tague et al. (2005) compiled seven new tools as a breakthrough strategic planning process that links visionary goals to work plans. Among those, Storyboard and Mind Maps are helpful to summarise and present the set of intervening elements to understand the problem to analyse, especially by Senior Managers who are usually very short in time.

METHODOLOGY

Research scope

This study evaluated the perspective of the supply chain beyond the limits of the factory, including suppliers (e.g. supplies, raw milk, services), distributors, customers, and consumers (market). The ADVC consists of several stages, going from the dairy farm unit to the customers-consumers units, through transformation (processing or production as equivalent) and supply. The ADVC has the same structure across companies in the sector. Because milk is a perishable and costly raw material to keep before it is processed, it introduces tensions in the operating strategy, making transformation and logistics critical factors for competitiveness. The study prioritises examining the milk reception at the factory through its transformation, including warehouse supplies and the finished product warehouse until the product arrives and the customer handles it. This study included three stages (initial, central and final processing), and 15 origins were identified, connected to 39 primary causes and 30 factors, composed of five clusters and three levels of impacts were determined.

Collected data

The adopted research method consisted of a desk-based study and a questionnaire with dairy experts' validation applied in semi-structured interviews with facilities' referents. After collecting and processing the information, an analysis characterised the dairy sector. The period study was between 2018 and 2019. The background for this study came from a bibliographic search. It also included data collected from numerous dairy plants (small, medium and large companies, multi-products, or specialised in a mix of products, national and international) that came from authors, experts, and colleagues interested in the topic. The National Dairy Direction (DNL, 2019) provided relevant information through the database "Survey and Evaluation of the Competitiveness of the Dairy Industry, Argentina 2016-2018" ("National Survey"), which is the most comprehensive information about this sector.

The process to design, collect, analyse, interpret, validate, and conclude the main findings of this research work is in Figure 1.

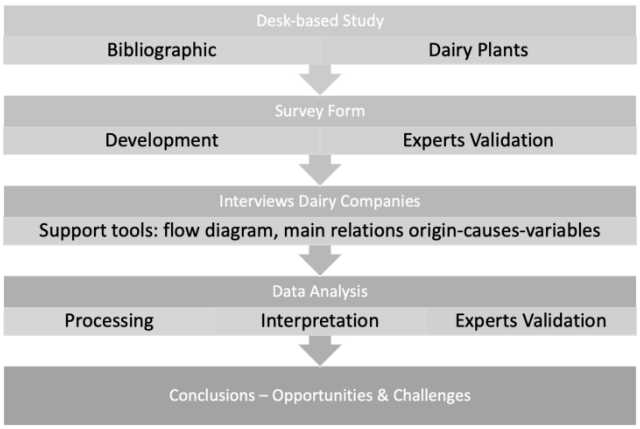

Figure 1. The methodology applied in this research

Source: Authors

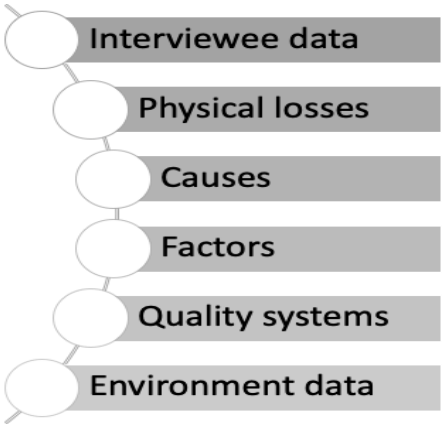

Figure 2. Questionnaire main blocks

Source: Authors

Questionnaire and Semi-structured interview design

A questionnaire (Figure 2), designed to collect data, included different companies and adapted to the context through a spreadsheet. The final design came from contributions based on Saunders et al. (2016).

The questionnaire design was to obtain in-depth information on the interviewed companies to assess the PL's knowledge, origins, causes, and factors. Complementary data allows a detailed diagnosis of quality, environment, new methodologies for operational management, cultural context, training, communication forms, and benchmarking. The experts reviewed these parts to optimise the consultations, give agility to the interview, and leave room to receive the interviewees' perspective, ensuring minimising deviations from the objective. The semi-structured interview followed the guidelines of Galletta (2013). This type of interview is part of a qualitative research set and is very useful when the consultations serve as a guide and are left open to add more information from both parties. It is necessary to carefully prepare and test the interview to generate empathy with company personnel, particularly in small organisations. In order to get the best results, these semi-structured interviews imply contacting the dairy companies' main referents, preferably at strategic and tactical levels. Direct contact allowed explaining the objective of the survey and the meaning of some questions that could generate doubts. An interesting side effect is the extra contributions that arose from the exchange with the interviewees once they provided their answers.

Interviews with Dairy Companies

As Saunders et al. (2016) remark, sensitive information requires a certain level of trust in the interviewer. So, semi-structured interviews were conducted in person (meaning face-to-face or telephone), using the questionnaire as a basis during the consultation. A meeting list organised the interviews with different companies' referents. Respondents received explanations and provided qualified data.

The interviewer counted with a flow diagram for processing lines (cheese, liquid milk, powdered milk, fermented milk, and multiple product lines) as supporting material. Also, during the interview, there was an emphasis on observing management and logistics practices.

Finally, data collected from companies were analysed and compiled in a spreadsheet form, identified as "Study Survey".

Data analysis

To characterise the value chain, the research team processed two primary sources of data: the "Study Survey" and the "National Survey". Information extracted from the "National Survey" allowed us to group in productive strata (or ranks), industrial structures, geographic location, and various practices related to the objective of this research that allowed us to compare and enrich the analysis of the "Study Survey". A common database, in a spreadsheet format, integrated data collected from the "Study Survey". The research team interpreted data by applying a descriptive analysis, figures, and tables (Santos, 2018). The answers considered Origins, Causes, Factors, and other dimensions of the companies (e.g. training, environmental practices, quality, safety and occupational health, management, were among the most important). The conversion of PL estimates was through a Likert-type scale (Saunders et al., 2016), from five to one, where five means the maximum value and one is the minimum one. So, PL was able to compare companies and Causes as Origins links according to the impact of the Cause on each origin. A final round of consultations with the experts corrected any possible deviation to ensure a correct understanding of the obtained information. It included an agreement about the relative weight of Origins and Causes to have a referential basis concerning the survey. The study's main findings were synthesised, including the fields not covered (e.g., Dairy Farm and Consumers Units) and suggestions for future research. For example, an interesting approach delves into a particular company and its value chain to evaluate concrete results, including consumption of industrial services and comparing with best practices.

The study shows the opportunities for Argentinean dairy value chain and the challenges for its implementation and improvement in pursuit of greater competitiveness.

RESULTS AND DISCUSSION

Characterization of the Argentinean dairy sector

This analysis includes the Argentinean dairy value chain, except Dairy Farm and Consumers. During the research, there were 659 companies processing milk or milk by-products, like cheese whey, operating in the country. Also, the value chain processed and marketed around 10,000 million litres of milk per year, with an annual gross turnover of 8,993 million USD between distribution, industry, and milk producers (farmers). With 577 companies processing raw milk; the majority were in the central area of Argentina (Buenos Aires, Córdoba, Santa Fe, Entre Ríos, and La Pampa provinces). An amount of 195 plants processed milk and eight used cheese whey or other raw materials instead of fluid milk from the interviewee representing around 80% of raw milk processed.

Processing, Interpretation, and Correlations of the survey data

The first step consisted of integrating data from the survey in a spreadsheet, like a database. Then, different data was extracted, applying ranks defined by processed milk and product mix. Next, a sequential analysis was initiated, comparing the weights of the PL by their origin, then by their Causes, and linking the Factors that impact the Causes. This step was the basis for PL economic impact estimated.

Economic impact of PL in ADVC

The percentage of PF (%PF), as a whole estimation, came from data supplied during the interviews and validated with dairy experts. Incoming information from OCLA allowed to transform this %PF into an economic value. The experts estimate an order of 3 to 7% of the dairy factory FOB billing considered in this study, not including dairy farm production nor consumer-level wastes. Consequently, these are significant amounts, especially when profitability levels are usually adequate if they exceed 5 to 6% of results before EBIDTA (Earnings Before Interest, Depreciation, Taxes, and Amortisation). The Physical losses (PL) estimated in the ADVC represent approximately USD 250 million annually. A huge cypher because this chain just created value by 180 million USD during 2019, as OCLA (2021) pointed out in their chain value reports.

Origins, Causes and Factors in PL Identification

In Table 1, the interviewees identified, using the Likert-type scale, their perceptions about PL in their companies from the different Origins.

Table 1. Dairy Industry share by milk volume processed and percentage of PL Origins per rank. Source: Authors.

The rank of milk processed [litres/day] and percentage of the interviewee	Percentage of PL Initial processing	Percentage of PL Central processing	Percentage of PL Final processing
1-50,000 (71%)	28%	48%	24%
50,001-500,000 (22%)	28%	46%	26%
> 500,000 (7%)	28%	46%	26%

All ranks should prioritise the central processing as the first step to find solutions. Following, they identified the leading causes in Table 2.

Table 2. Leading PL Causes per rank. Source: Authors.

The rank of milk processed [litres/day]	Percentage of Causes per rank in Central processing	Three main Causes Identified
1-50,000	46%	Human error Variation offers raw milk seasonality Measurement systems
50,001-500,000	56%	Human error

		Design of facilities Measurement systems
> 500,000	51%	Human error Design of facilities Data error

An interesting issue came from Table 2. The Cause "Human Error" was the top Cause identified in all ranks. Sequencing the Factors connected to "Human Error" were summarised in Training, Internal communication, Automation level, Operating Instructions, PL Policy and Culture. Most of the Factors are low cost to implement, but they depend on Top Management's commitment (TMC) to be aware of PL and how these soft Factors are essential to solving. These findings were in line with previous authors when they interpreted TMC as a critical barrier.

CONCLUSIONS

Through this investigation, the characterisation of PL in the ADVC determined the leading Origins, Causes and Factors by milk processing rank. This "Study Survey" data combined with the "National Survey" generated a database that allows various studies on this value chain, including economic impacts. This document is a significant contribution because it represents the sector under study and covers a theoretical aspect, linking the PL with the Causes and their Factors for the Argentinean dairy industry. The main innovation came from transforming perceptions into actionable information, and it is possible to extrapolate it to other value chains with specific adjustments.

Other contribution of this study was the Experts' support to optimise the questionnaire, improve the interviews, and validate data from interviews. At the same time, the research team could get accurate data from various sources to validate what arose from the Origin-Causes relations.

The semi-structured interview format is a valuable methodology to perceive the PL to obtain data to enrich the study. For example, the percentage of PL, grade of importance to the use of natural resources, the conception of sustainability, and the Cause of the minimum action on these PL. The relational tables were crucial to prioritise and compare the importance of Causes and the areas of influence that allow identifying those requiring a smaller investment with a significant impact, such as human error.

Another essential contribution to value chain under study is the generation of information to evaluate without high costs, the technical-economic pre-feasibility of operating on the PL and being more sustainable. The AVDC performed a value creation of around 180 million USD in 2019 but lost 250 million USD in PL annually. This study identified that 50% lost came from central processing, where Human Error is the leading cause. Factors like: Training, Internal communication, Automation level, Operating Instructions, PL Policy and Culture were critical to modify Human Error Cause.

This article leaves open the extension to Dairy Farm and Consumers Units in future research lines, with two critical sources of environmental impact: greenhouse gases and food waste. An

in-depth study could also be carried out in a specific dairy company to verify data and propose a viable methodology for approaching a problem resolution.

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